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## PATENT ABSTRACTS OF JAPAN

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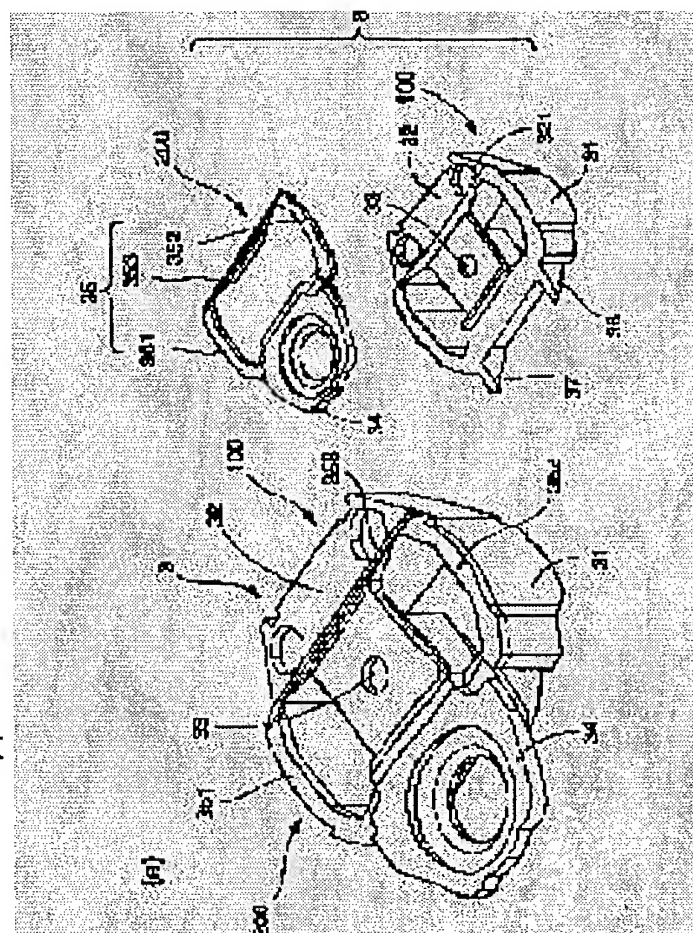
HAYAKAWA MASAMICHI

### (54) OBJECTIVE LENS DRIVING DEVICE

#### (57)Abstract:

PROBLEM TO BE SOLVED: To provide an objective lens driving device equipped with light-weight and highly rigid lens holder.

SOLUTION: The lens holder 3 of an objective lens driving device is a composite component integrating first and second part items 100 and 200 and the first part item 100 is a molded article made of resin such as PPS. The second part item 200 is a molded product made of a carbon fiber laminate material, and has a lens attaching part 34. By using the lens holder 3 constructed in this manner, compared with a lens holder as a single product made of a resin molding material, the mass is reduced, and a high-order resonance frequency in a focusing direction is increased. Thus, the objective lens driving device equipped with the lens holder, which has high responsiveness and hardly causes resonance is realized.



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CLAIMS

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[Claim(s)]

[Claim 1] It is the objective lens driving gear which said lens holder is the composite part constituted by unifying the 1st and 2nd components at least in the objective lens driving gear which has an objective lens, a lens holder holding this objective lens, and the drive made to move this lens holder in the direction which intersects perpendicularly with the direction of a lens-optical axis, and the lens-optical axis concerned, and is characterized by forming said 2nd component at least from the carbon fiber laminated wood.

[Claim 2] It is the objective lens driving gear which said 2nd component is plate-like components in claim 1, and is characterized by carrying out orientation of the carbon fiber in the direction of a flat surface of the plate-like component concerned.

[Claim 3] It is the objective lens driving gear which said 2nd component is cylindrical components in claim 1, and is characterized by carrying out orientation of the carbon fiber to the circumferencial direction of the cylindrical components concerned.

[Claim 4] The objective lens driving gear characterized by attaching said objective lens in said 2nd component in claim 2.

[Claim 5] The objective lens driving gear characterized by attaching in said 2nd component either the magnet which constitutes said drive, or the drive coil in claim 3.

[Claim 6] It is the objective lens driving gear characterized by said 1st component being resin mold goods or a die-casting article in claim 1 thru/or which term of 5.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the lens holder which holds the objective lens especially about the objective lens driving gear in the optical pickup used for playback of a record medium etc.

[0002]

[Description of the Prior Art] The objective lens driving gear of an optical pickup consists of drives made to move an objective lens, the lens holder holding this objective lens, and this lens holder in the direction which intersects perpendicularly with the direction of a lens optical axis, and it, and by moving a lens holder in the direction of an optical axis, it is constituted so that a focusing error may be amended and a tracking error may be amended by moving a lens holder in the direction which intersects perpendicularly with an optical axis.

[0003] As such an objective lens driving gear, a lens holder is held for the direction of an axis of the rotation shaft concerned on a rotation shaft, enabling sliding free [ rotation ] and free, focusing error amendment is performed by sliding a lens holder in accordance with a rotation shaft with a magnetic drive, and the thing of an axial slide mold which performs tracking error amendment is known by rotating the lens holder concerned around a rotation shaft.

[0004] Here, although lens holders are generally resin mold goods or magnesium die-casting articles, such as PPS (polyphenylene sulfide) and LCP (liquid crystal resin), in order to improve the oscillation characteristic, they need to add a rib etc. and need to make it rigid high structure. Mass becomes large inevitably, a sensibility property gets worse, and it becomes impossible however, for the lens holder made to form into high rigidity structurally to correspond to a high-speed drive by the addition of a rib etc.

[0005] In view of such a point etc., previously, in JP,8-221785,A, this application people improve the quality of the material of the lens holder of the objective lens driving gear of an axial sliding mold, and are aiming at the improvement of vibration-deadening nature. That is, in this open official report, the improvement of vibration-deadening nature is aimed at by forming a lens holder from the charge of an admixture of the resin of oscillating absorptivity, such as PPS and LCP, and fillers, such as a carbon fiber.

[0006]

[Problem(s) to be Solved by the Invention] High moreover, the technical problem of this invention has rigidity in realizing a lightweight lens holder as a whole in an objective lens driving gear, without using such a charge of an admixture.

[0007]

[Means for Solving the Problem] this invention person came to realize a raise in rigidity and lightweight-izing of a lens holder using the material concerned paying attention to the carbon fiber laminated wood equipped with about the same high rigidity as a metal, and about the same small specific gravity as resin.

[0008] Namely, this invention is set to the objective lens driving gear which has an objective lens, a lens holder holding this objective lens, and the drive made to move this lens holder in the direction which intersects perpendicularly with the direction of a lens optical axis, and the lens optical axis concerned. Said lens holder is the composite part constituted by unifying the 1st and 2nd components at least, and it is characterized by forming said 2nd component from the carbon fiber laminated wood (carbon fiber sheet) at least.

[0009] Since a carbon fiber laminated wood is what unified the carbon fiber of the predetermined direction in the shape of a sheet in the resin used as the base and the direction of orientation of a carbon fiber is an one direction, the lens holder as a detail part is unproducible using a carbon fiber laminated wood. However, in this invention, it considers as composite part instead of using a lens holder as a detail part, and at least one of components [ them ] is formed from the carbon fiber laminated wood. Therefore, taking advantage of the property of a carbon fiber laminated wood, rigidity can realize a high lightweight lens holder as a whole.

[0010] Here, said 2nd component can be used as plate-like components or cylindrical components. When considering as plate-like components, it is desirable to make the direction of a flat surface of the plate-like member concerned into the direction of orientation of a carbon fiber. When considering as cylindrical components, it is desirable to make the circumferencial direction of the cylindrical member concerned into the direction of orientation of a carbon fiber.

[0011] Moreover, as for the 2nd component which consists of a rigid high carbon fiber laminated wood, it is desirable to use for the part to which the vibration or stress in a lens holder acts. An objective lens is attached in said 2nd component in a typical lens holder. Or either the magnet which constitutes said drive, or a drive coil is attached in said 2nd component.

[0012] On the other hand, said 1st member can be used as resin mold goods or a die-casting article.  
[0013]

[Embodiment of the Invention] The objective lens driving gear equipped with the lens holder which applied this invention to below with reference to the drawing is explained.

[0014] The top view and drawing 2 which show the objective lens driving gear of this example [ drawing 1 ] are the sectional view of the part cut by the II-II line in drawing 1 . As shown in these drawings, the objective lens driving gear 1 has an objective lens 2, the lens holder 3 holding this objective lens 2, and the holder supporter material 4 that is supporting this lens holder 3.

[0015] The holder supporter material 4 is equipped with the bottom wall 41 of an abbreviation rectangle, and the side attachment walls 42-45 which started from the neighborhood of a bottom wall 41 perpendicularly. Adhesion immobilization of the tracking drive magnets 51 and 52 by which polarization magnetization was carried out in the hoop direction is carried out at the medial surface of the side attachment walls 42 and 43 mutually prolonged in parallel among these side attachment walls 42-45, respectively.

[0016] Moreover, from the bottom wall 41, the walls 47 and 48 of the pair prolonged in parallel to the side attachment walls 42 and 43 with which the tracking drive magnets 51 and 52 were attached are started. Adhesion immobilization of the focusing drive magnets 61 and 62 with which the field magnetized by the single electrode is suitable inside is carried out at the medial surface of walls 47 and 48, respectively.

[0017] Furthermore, the sliding shaft 46 is being fixed to the center section of the bottom wall 41 inserted with the walls 47 and 48 of a pair. The lens holder 3 is supported by this sliding shaft 46.

[0018] A lens holder 3 is the composite part constituted by unifying the 1st and 2nd components 100,200 (referring to drawing 3 ), and is equipped with the cylinder-like drum section 31 and the bearing 33 of the shape of a cylinder formed in the shape of the same axle the wrap top plate 32 and inside the drum section 31 in the drum section 31 bottom so that it may mention later. The lens installation section 34 thinly juttred out towards the outside is formed in the top plate 32, and adhesion immobilization of the objective lens 2 is carried out on this. Moreover, on both sides of the bearing 33, the openings 321 and 322 of a pair are formed in the location of both sides among top plates 32.

[0019] The sliding shaft 46 which stood straight from the bottom wall 41 of the holder supporter



material 4 is inserted in the boss 331 formed in the bearing 33 of this lens holder 3. Moreover, inside the openings 321 and 322 of the pair formed in the top plate 32 of a lens holder 3, the walls 47 and 48 of the pair which stood straight from the bottom wall 41 of the holder supporter material 3 are inserted, respectively. Therefore, the bearing 33 of a lens holder 3 is located among the focusing drive magnets 61 and 62 attached in the walls 47 and 48 of a pair.

[0020] The focusing drive coil 63 is twisted around the bearing 33 of a lens holder 3. Between this focusing drive coil 63 and the focusing drive magnets 61 and 62, the focusing MAG drive circuit to which a lens holder 3 is moved up and down in accordance with the sliding shaft 46 is constituted.

[0021] Moreover, the tracking drive coils 53 and 54 of a pair are attached in the peripheral face of the drum section 31 of a lens holder 3 so that face to face may be stood against the tracking drive magnets 51 and 52. Between these tracking drive coils 53 and 54 and the tracking drive magnets 51 and 52, the tracking MAG drive circuit which rotates a lens holder 3 around the sliding shaft 46 is constituted.

[0022] Next, drawing 3 (a) and (b) are the perspective views and decomposition perspective views of a lens holder 3, respectively. As shown in these drawings, the lens holder 3 of this example is constituted by unifying the 1st components 100 and 2nd component 200. The 1st component 100 is the mold goods of PPS, and a part for the cylinder-like drum section 31, a top plate 32, and a bearing 33 is formed.

[0023] On the other hand, the 2nd component 200 is mold goods which consist of a carbon fiber laminated wood, the monotonous configuration is carried out as a whole, and the circular ring-like lens installation section 34 is formed.

[0024] The installation section 35 by the side of the 1st component 100 is formed in the 2nd component 200 succeeding the lens installation section 34. This installation section 35 is formed from the circular parts 351 and 352 of the pair which is following the lens installation section 34, and the joining segment 353 with which mutual has connected the tip of these circular parts 351 and 352. The circular parts 351 and 352 are being fixed to the top face of the shape of radii of right and left of the top plate 32 of the drum section 31 of the 1st component 100. The joining segment 353 is being fixed in the condition formed in the top plate 32 of the 1st component 100 of having inserted and having been inserted in the slot 321.

[0025] In addition, the overhang sections 37 and 38 of the pair for supporting the lens installation section 34 of the 2nd component 200 are formed in the 1st component 100.

[0026] Thus, compared with the case where the lens holder 3 in the constituted objective lens driving gear 1 of this example fabricates the whole lens holder by resin, such as PPS, excelling in respect of mass, moment of inertia, and natural frequency was checked.

[0027] (Another example of a lens holder) Another example of a configuration of a lens holder 3 is shown in drawing 4. It is the composite part with which lens-holder 3A shown in this drawing also consisted of the 1st components 300 and 2nd component 400. This whole lens-holder 3A configuration is the same as that of a lens holder 3, and the 1st component 300 is mold goods which consist of PPS, and the 2nd component 400 is mold goods which consist of a carbon fiber laminated wood.

[0028] However, in this example, the 2nd component 400 is cylindrical components and the drum section 31 of lens-holder 3A and the top-plate part of the upper limit are formed. Parts other than this are formed with the 1st component 300. It inserts in between for the bearing [ 34 ] of the lens installation section 34 and center, the slot 381 is formed in the 1st component 300, and it is in the condition that the side-attachment-wall part 401 by the side of the lens installation section of the 4th component 400 was inserted and fixed here. Adhesion immobilization of the side-attachment-wall part 402 of the opposite side of the 4th component 400 is carried out at the attaching end face 382 formed in the 3rd component 300. In the 4th component 400, the peripheral face of the side-attachment-wall parts 403 and 404 of the shape of radii connected to the both ends of the side-attachment-wall parts 401 and 402 is the clamp face of the drive coils 53 and 54 for tracking.

[0029] (Example of analysis) this invention person etc. performed FEM analysis using the lens holders 3 and 3A in the objective lens driving gear 1 of the above-mentioned configuration, and the lens holder as a detail part which consists of PPS of the same configuration.

[0030] The ingredient constant of PPS which is the material of construction, and a carbon fiber

laminated wood is shown in Table 1. Moreover, an analysis result is shown in Table 2.

[0031]

[Table 1]

#### 材 料 定 数

|              | ヤング率<br>( $\text{mN/mm}^2$ ) | ポアソン比 | 密 度<br>( $\text{kg/mm}^3$ ) |
|--------------|------------------------------|-------|-----------------------------|
| P P S        | $2.2 \times 10^7$            | 0.3   | $1.96 \times 10^{-6}$       |
| カーボンファイバー積層材 | $1.5 \times 10^8$            | 0.3   | $1.60 \times 10^{-6}$       |

[0032]

[Table 2]

#### 解 析 結 果

単位系 [mm/kg/mN/kHz]

|             | ホルダ質量                  | P P S 材質量              | カーボンファイバー<br>積層材質量      | 慣性モーメント<br>(トラック方向)    | ねじれ振動<br>モード | F 方向振動<br>モード |
|-------------|------------------------|------------------------|-------------------------|------------------------|--------------|---------------|
| PPS型のレンズホルダ | $2.178 \times 10^{-4}$ | $2.178 \times 10^{-4}$ | —                       | $3.657 \times 10^{-9}$ | 19.041       | 21.826        |
| レンズホルダ 3    | $2.099 \times 10^{-4}$ | $1.747 \times 10^{-4}$ | $0.351 \times 10^{-4}$  | $3.438 \times 10^{-9}$ | 23.584       | 28.482        |
| レンズホルダ 3 A  | $2.017 \times 10^{-4}$ | $1.302 \times 10^{-4}$ | $0.7153 \times 10^{-4}$ | $3.372 \times 10^{-9}$ | 29.778       | 26.570        |

[0033] As shown in Table 2, when the lens holders 3 and 3A by this invention were used, having reduced the mass of a lens holder about 3 to 7% was checked. Moreover, having reduced moment of inertia about 6 to 8% was checked.

[0034] Furthermore, about high order resonance of a lens holder, vibration of the direction of focusing (the direction of F) poses a problem, and, in the case of the lens holder 3 which formed the lens installation section 34 with the carbon fiber laminated wood, it was checked that the resonant frequency had carried out the about 6.7kHz (about 30%) rise compared with the lens holder made from PPS. It was checked that the resonant frequency had carried out the about 4.7kHz (about 21.7%) rise compared with the lens holder made from PPS also in lens-holder 3A in which similarly the drum section 31 which is the installation part of the drive coil for tracking is formed from the carbon fiber laminated wood.

[0035] (Gestalt of other operations) A lens holder is constituted from each still more nearly above-mentioned example by unifying two components, and one of components [ them ] is formed with the carbon fiber laminated wood. However, what is necessary is to be also able to constitute a lens holder from three or more components, and just to form one piece or two components or more in those components from a carbon fiber laminated wood in this case.

[0036] Here, while constituting a lens holder from two or more components, such each part articles can also be formed from a carbon fiber laminated wood.

[0037] Next, adhesives may be used for the approach for unifying each part article of a lens holder, and insert molding can also be used for it.

[0038] On the other hand, although the 1st component is made into the product made from PPS in each above-mentioned example, the 1st component can also be formed using a different resin ingredient from this. Moreover, it can also consider as die-casting articles, such as magnesium.

[0039]

[Effect of the Invention] As explained above, while constituting the lens holder by unifying the 1st and 2nd components at least in the objective lens driving gear of this invention, it is characterized by



forming the 2nd component from a carbon fiber laminated wood at least.

[0040] Since the sensibility of the direction of focusing is improved since the lens holder by this invention can make mass small compared with the resin mold goods or the die-casting article it is unrefined from a detail part, and moment of inertia is reduced, the sensibility of the direction of tracking is also improved. In addition, since a natural frequency can be raised, while high order resonance frequency becomes high, the peak value of a vibration level is also reduced.

[0041] Thus, according to this invention, responsibility is good and the objective lens driving gear moreover equipped with the lens holder which high order resonance cannot generate easily can be realized.

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TECHNICAL FIELD

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[Field of the Invention] This invention relates to the lens holder which holds the objective lens especially about the objective lens driving gear in the optical pickup used for playback of a record medium etc.

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PRIOR ART

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[Description of the Prior Art] The objective lens driving gear of an optical pickup consists of drives made to move an objective lens, the lens holder holding this objective lens, and this lens holder in the direction which intersects perpendicularly with the direction of a lens optical axis, and it, and by moving a lens holder in the direction of an optical axis, it is constituted so that a focusing error may be amended and a tracking error may be amended by moving a lens holder in the direction which intersects perpendicularly with an optical axis.

[0003] As such an objective lens driving gear, a lens holder is held for the direction of an axis of the rotation shaft concerned on a rotation shaft, enabling sliding free [ rotation ] and free, focusing error amendment is performed by sliding a lens holder in accordance with a rotation shaft with a magnetic drive, and the thing of an axial slide mold which performs tracking error amendment is known by rotating the lens holder concerned around a rotation shaft.

[0004] Here, although lens holders are generally resin mold goods or magnesium die-casting articles, such as PPS (polyphenylene sulfide) and LCP (liquid crystal resin), in order to improve the oscillation characteristic, they need to add a rib etc. and need to make it rigid high structure. Mass becomes large inevitably, a sensibility property gets worse, and it becomes impossible however, for the lens holder made to form into high rigidity structurally to correspond to a high-speed drive by the addition of a rib etc.

[0005] In view of such a point etc., previously, in JP,8-221785,A, this application people improve the quality of the material of the lens holder of the objective lens driving gear of an axial sliding mold, and are aiming at the improvement of vibration-deadening nature. That is, in this open official report, the improvement of vibration-deadening nature is aimed at by forming a lens holder from the charge of an admixture of the resin of oscillating absorptivity, such as PPS and LCP, and fillers, such as a carbon fiber.

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EFFECT OF THE INVENTION

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[Effect of the Invention] As explained above, while constituting the lens holder by unifying the 1st and 2nd components at least in the objective lens driving gear of this invention, it is characterized by forming the 2nd component from a carbon fiber laminated wood at least.

[0040] Since the sensibility of the direction of focusing is improved since the lens holder by this invention can make mass small compared with the resin mold goods or the die-casting article it is unrefined from a detail part, and moment of inertia is reduced, the sensibility of the direction of tracking is also improved. In addition, since a natural frequency can be raised, while high order resonance frequency becomes high, the peak value of a vibration level is also reduced.

[0041] Thus, according to this invention, responsibility is good and the objective lens driving gear moreover equipped with the lens holder which high order resonance cannot generate easily can be realized.

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TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] High moreover, the technical problem of this invention has rigidity in realizing a lightweight lens holder as a whole in an objective lens driving gear, without using such a charge of an admixture.

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MEANS

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[Means for Solving the Problem] this invention person came to realize a raise in rigidity and lightweight-izing of a lens holder using the material concerned paying attention to the carbon fiber laminated wood equipped with about the same high rigidity as a metal, and about the same small specific gravity as resin.

[0008] Namely, this invention is set to the objective lens driving gear which has an objective lens, a lens holder holding this objective lens, and the drive made to move this lens holder in the direction which intersects perpendicularly with the direction of a lens optical axis, and the lens optical axis concerned. Said lens holder is the composite part constituted by unifying the 1st and 2nd components at least, and it is characterized by forming said 2nd component from the carbon fiber laminated wood (carbon fiber sheet) at least.

[0009] Since a carbon fiber laminated wood is what unified the carbon fiber of the predetermined direction in the shape of a sheet in the resin used as the base and the direction of orientation of a carbon fiber is an one direction, the lens holder as a detail part is unproducible using a carbon fiber laminated wood. However, in this invention, it considers as composite part instead of using a lens holder as a detail part, and at least one of components [ them ] is formed from the carbon fiber laminated wood. Therefore, taking advantage of the property of a carbon fiber laminated wood, rigidity can realize a high lightweight lens holder as a whole.

[0010] Here, said 2nd component can be used as plate-like components or cylindrical components. When considering as plate-like components, it is desirable to make the direction of a flat surface of the plate-like member concerned into the direction of orientation of a carbon fiber. When considering as cylindrical components, it is desirable to make the circumferencial direction of the cylindrical member concerned into the direction of orientation of a carbon fiber.

[0011] Moreover, as for the 2nd component which consists of a rigid high carbon fiber laminated wood, it is desirable to use for the part to which the vibration or stress in a lens holder acts. An objective lens is attached in said 2nd component in a typical lens holder. Or either the magnet which constitutes said drive, or a drive coil is attached in said 2nd component.

[0012] On the other hand, said 1st member can be used as resin mold goods or a die-casting article.

[0013]

[Embodiment of the Invention] The objective lens driving gear equipped with the lens holder which applied this invention to below with reference to the drawing is explained.

[0014] The top view and drawing 2 which show the objective lens driving gear of this example [ drawing 1 ] are the sectional view of the part cut by the II-II line in drawing 1 . As shown in these drawings, the objective lens driving gear 1 has an objective lens 2, the lens holder 3 holding this objective lens 2, and the holder supporter material 4 that is supporting this lens holder 3.

[0015] The holder supporter material 4 is equipped with the bottom wall 41 of an abbreviation rectangle, and the side attachment walls 42-45 which started from the neighborhood of a bottom wall 41 perpendicularly. Adhesion immobilization of the tracking drive magnets 51 and 52 by which polarization magnetization was carried out in the hoop direction is carried out at the medial surface of



the side attachment walls 42 and 43 mutually prolonged in parallel among these side attachment walls 42-45, respectively.

[0016] Moreover, from the bottom wall 41, the walls 47 and 48 of the pair prolonged in parallel to the side attachment walls 42 and 43 with which the tracking drive magnets 51 and 52 were attached are started. Adhesion immobilization of the focusing drive magnets 61 and 62 with which the field magnetized by the single electrode is suitable inside is carried out at the medial surface of walls 47 and 48, respectively.

[0017] Furthermore, the sliding shaft 46 is being fixed to the center section of the bottom wall 41 inserted with the walls 47 and 48 of a pair. The lens holder 3 is supported by this sliding shaft 46.

[0018] A lens holder 3 is the composite part constituted by unifying the 1st and 2nd components 100,200 (referring to drawing 3 ), and is equipped with the cylinder-like drum section 31 and the bearing 33 of the shape of a cylinder formed in the shape of the same axle the wrap top plate 32 and inside the drum section 31 in the drum section 31 bottom so that it may mention later. The lens installation section 34 thinly jutted out towards the outside is formed in the top plate 32, and adhesion immobilization of the objective lens 2 is carried out on this. Moreover, on both sides of the bearing 33, the openings 321 and 322 of a pair are formed in the location of both sides among top plates 32.

[0019] The sliding shaft 46 which stood straight from the bottom wall 41 of the holder supporter material 4 is inserted in the boss 331 formed in the bearing 33 of this lens holder 3. Moreover, inside the openings 321 and 322 of the pair formed in the top plate 32 of a lens holder 3, the walls 47 and 48 of the pair which stood straight from the bottom wall 41 of the holder supporter material 3 are inserted, respectively. Therefore, the bearing 33 of a lens holder 3 is located among the focusing drive magnets 61 and 62 attached in the walls 47 and 48 of a pair.

[0020] The focusing drive coil 63 is twisted around the bearing 33 of a lens holder 3. Between this focusing drive coil 63 and the focusing drive magnets 61 and 62, the focusing MAG drive circuit to which a lens holder 3 is moved up and down in accordance with the sliding shaft 46 is constituted.

[0021] Moreover, the tracking drive coils 53 and 54 of a pair are attached in the peripheral face of the drum section 31 of a lens holder 3 so that face to face may be stood against the tracking drive magnets 51 and 52. Between these tracking drive coils 53 and 54 and the tracking drive magnets 51 and 52, the tracking MAG drive circuit which rotates a lens holder 3 around the sliding shaft 46 is constituted.

[0022] Next, drawing 3 (a) and (b) are the perspective views and decomposition perspective views of a lens holder 3, respectively. As shown in these drawings, the lens holder 3 of this example is constituted by unifying the 1st components 100 and 2nd component 200. The 1st component 100 is the mold goods of PPS, and a part for the cylinder-like drum section 31, a top plate 32, and a bearing 33 is formed.

[0023] On the other hand, the 2nd component 200 is mold goods which consist of a carbon fiber laminated wood, the monotonous configuration is carried out as a whole, and the circular ring-like lens installation section 34 is formed.

[0024] The installation section 35 by the side of the 1st component 100 is formed in the 2nd component 200 succeeding the lens installation section 34. This installation section 35 is formed from the circular parts 351 and 352 of the pair which is following the lens installation section 34, and the joining segment 353 with which mutual has connected the tip of these circular parts 351 and 352. The circular parts 351 and 352 are being fixed to the top face of the shape of radii of right and left of the top plate 32 of the near drum section 31 of the 1st component 100. The joining segment 353 is being fixed in the condition formed in the top plate 32 of the 1st component 100 of having inserted and having been inserted in the slot 321.

[0025] In addition, the overhang sections 37 and 38 of the pair for supporting the lens installation section 34 of the 2nd component 200 are formed in the 1st component 100.

[0026] Thus, compared with the case where the lens holder 3 in the constituted objective lens driving gear 1 of this example fabricates the whole lens holder by resin, such as PPS, excelling in respect of mass, moment of inertia, and natural frequency was checked.

[0027] (Another example of a lens holder) Another example of a configuration of a lens holder 3 is shown in drawing 4 . It is the composite part with which lens-holder 3A shown in this drawing also

consisted of the 1st components 300 and 2nd component 400. This whole lens-holder 3A configuration is the same as that of a lens holder 3, and the 1st component 300 is mold goods which consist of PPS, and the 2nd component 400 is mold goods which consist of a carbon fiber laminated wood.

[0028] However, in this example, the 2nd component 400 is cylindrical components and the drum section 31 of lens-holder 3A and the top-plate part of the upper limit are formed. Parts other than this are formed with the 1st component 300. It inserts in between for the bearing [ 34 ] of the lens installation section 34 and center, the slot 381 is formed in the 1st component 300, and it is in the condition that the side-attachment-wall part 401 by the side of the lens installation section of the 4th component 400 was inserted and fixed here. Adhesion immobilization of the side-attachment-wall part 402 of the opposite side of the 4th component 400 is carried out at the attaching end face 382 formed in the 3rd component 300. In the 4th component 400, the peripheral face of the side-attachment-wall parts 403 and 404 of the shape of radii connected to the both ends of the side-attachment-wall parts 401 and 402 is the clamp face of the drive coils 53 and 54 for tracking.

[0029] (Example of analysis) this invention person etc. performed FEM analysis using the lens holders 3 and 3A in the objective lens driving gear 1 of the above-mentioned configuration, and the lens holder as a detail part which consists of PPS of the same configuration.

[0030] The ingredient constant of PPS which is the material of construction, and a carbon fiber laminated wood is shown in Table 1. Moreover, an analysis result is shown in Table 2.

[0031]

[Table 1]

材 料 定 数

|              | ヤング率<br>( $\text{mN/mm}^2$ ) | ポアソン比 | 密 度<br>( $\text{kg/mm}^3$ ) |
|--------------|------------------------------|-------|-----------------------------|
| P P S        | $2.2 \times 10^7$            | 0.3   | $1.96 \times 10^{-6}$       |
| カーボンファイバー積層材 | $1.5 \times 10^8$            | 0.3   | $1.60 \times 10^{-6}$       |

[0032]

[Table 2]

解 析 結 果

単位系 [mm/kg/mN/kHz]

|             | ホルダ質量                  | P P S 材質量              | カーボンファイバー<br>積層材質量      | 慣性モーメント<br>(トラック方向)    | ねじれ振動<br>モード | F 方向振動<br>モード |
|-------------|------------------------|------------------------|-------------------------|------------------------|--------------|---------------|
| PPS型のレンズホルダ | $2.178 \times 10^{-4}$ | $2.178 \times 10^{-4}$ | —                       | $3.657 \times 10^{-8}$ | 19.041       | 21.826        |
| レンズホルダ 3    | $2.099 \times 10^{-4}$ | $1.747 \times 10^{-4}$ | $0.351 \times 10^{-4}$  | $3.438 \times 10^{-8}$ | 23.584       | 28.482        |
| レンズホルダ 3 A  | $2.017 \times 10^{-4}$ | $1.302 \times 10^{-4}$ | $0.7153 \times 10^{-4}$ | $3.372 \times 10^{-8}$ | 29.778       | 26.570        |

[0033] As shown in Table 2, when the lens holders 3 and 3A by this invention were used, having reduced the mass of a lens holder about 3 to 7% was checked. Moreover, having reduced moment of inertia about 6 to 8% was checked.

[0034] Furthermore, about high order resonance of a lens holder, vibration of the direction of focusing (the direction of F) poses a problem, and, in the case of the lens holder 3 which formed the lens installation section 34 with the carbon fiber laminated wood, it was checked that the resonant frequency had carried out the about 6.7kHz (about 30%) rise compared with the lens holder made from PPS. It was checked that the resonant frequency had carried out the about 4.7kHz (about 21.7%) rise compared with

the lens holder made from PPS also in lens-holder 3A in which similarly the drum section 31 which is the installation part of the drive coil for tracking is formed from the carbon fiber laminated wood.

[0035] (Gestalt of other operations) A lens holder is constituted from each still more nearly above-mentioned example by unifying two components, and one of components [ them ] is formed with the carbon fiber laminated wood. However, what is necessary is to be also able to constitute a lens holder from three or more components, and just to form one piece or two components or more in those components from a carbon fiber laminated wood in this case.

[0036] Here, while constituting a lens holder from two or more components, such each part articles can also be formed from a carbon fiber laminated wood.

[0037] Next, adhesives may be used for the approach for unifying each part article of a lens holder, and insert molding can also be used for it.

[0038] On the other hand, although the 1st component is made into the product made from PPS in each above-mentioned example, the 1st component can also be formed using a different resin ingredient from this. Moreover, it can also consider as die-casting articles, such as magnesium.

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[Translation done.]

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the outline top view of the objective lens driving gear which applied this invention.

[Drawing 2] It is the outline sectional view of the part cut by the II-II line of the objective lens driving gear of drawing 1 .

[Drawing 3] (a) And (b) is the perspective view and decomposition perspective view showing the lens holder of the objective lens driving gear of drawing 1 , respectively.

[Drawing 4] (a) And (b) is the perspective view and decomposition perspective view showing the different example of the lens holder of drawing 3 , respectively.

[Description of Notations]

1 Objective Lens Driving Gear

2 Objective Lens

3 Lens Holder

31 Drum Section

32 Top Plate

33 Bearing

34 RENSU Installation Section

100,300 The 1st component of a lens holder

200,400 The 2nd component of a lens holder

4 Holder Support Plate

46 Sliding Shaft

51 52 Magnet for tracking

53 54 Drive coil for tracking

61 62 Magnet for focusing

63 Drive Coil for Focusing

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[Translation done.]

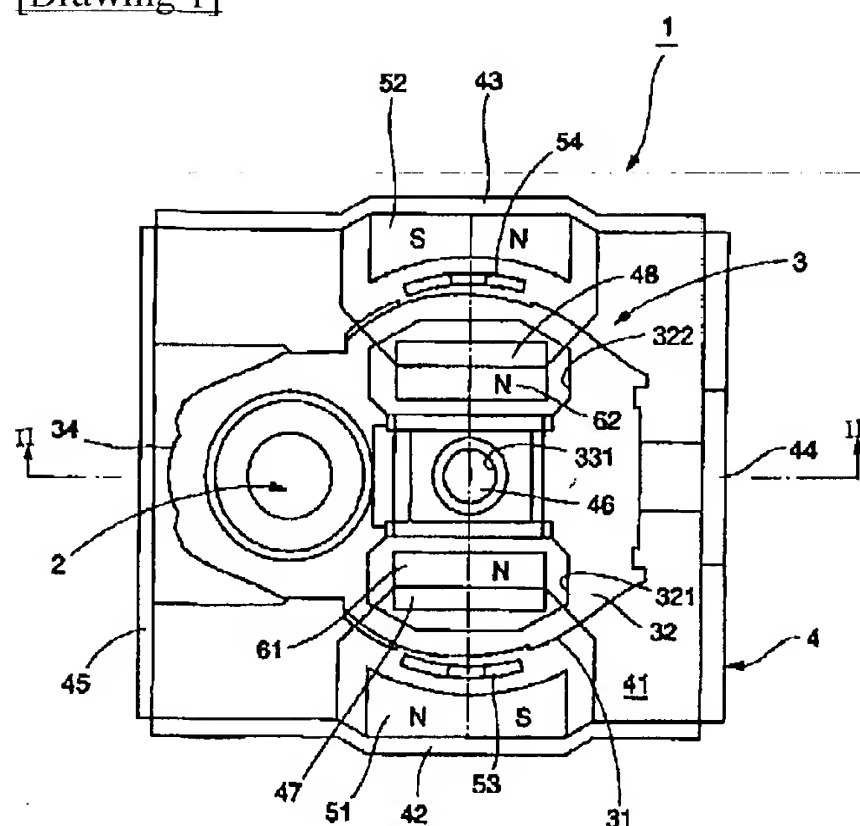
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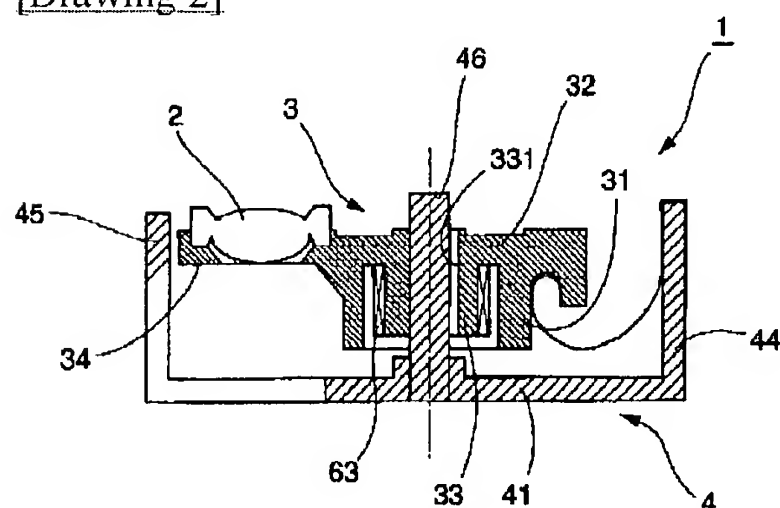
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## DRAWINGS

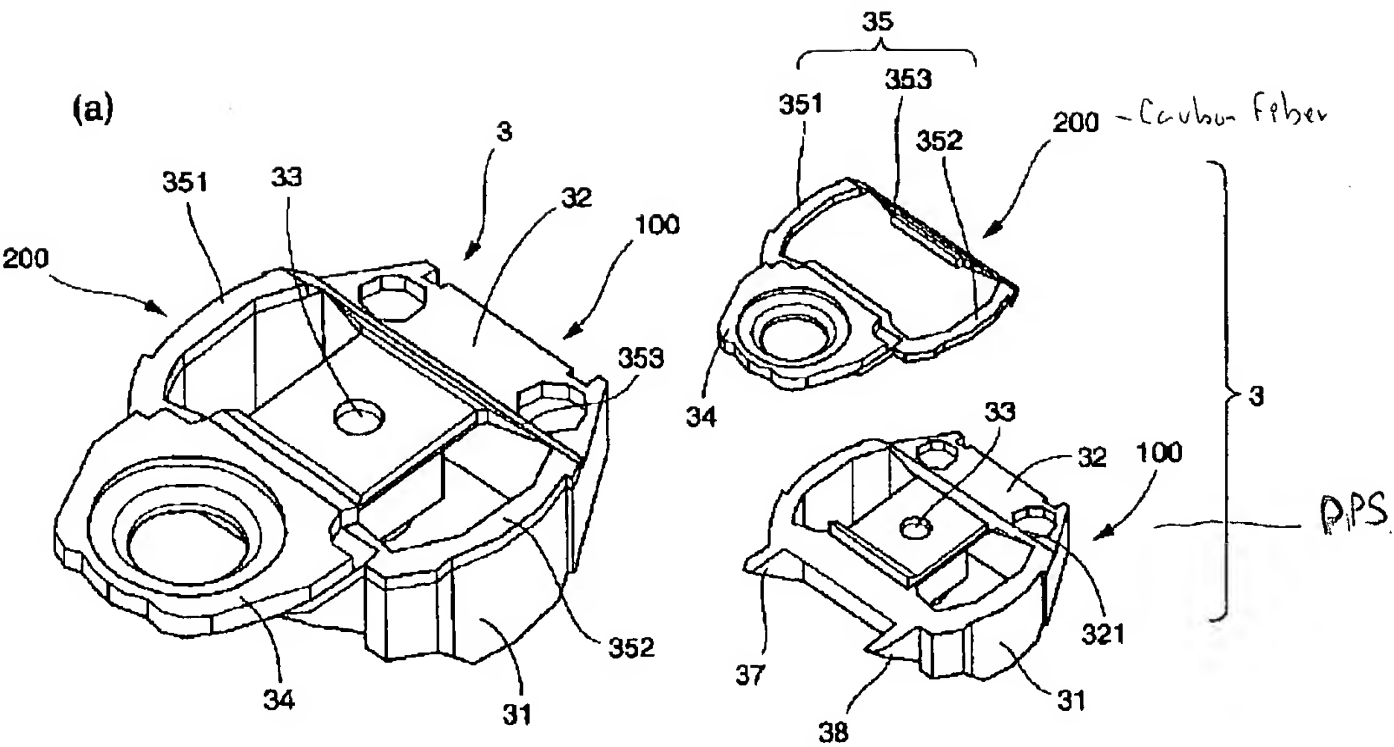
[Drawing 1]



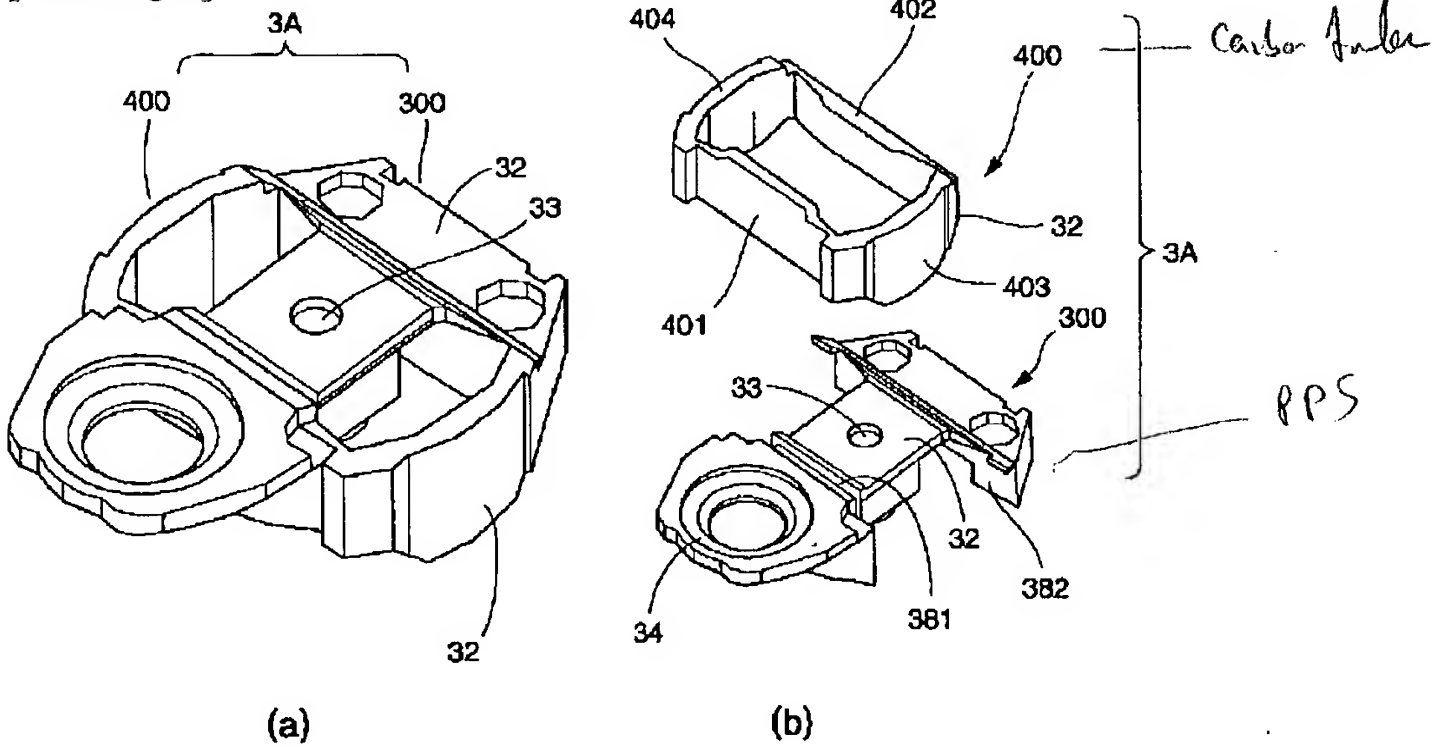
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]